In the previous post we discussed about Hydrostatics, whereby liquid was at rest. In this we will discuss about liquids in motion.

Initially at this Class XI level we take only ideal fluid.

Ideal Fluid: Incompressible, The density cannot change on application of pressure or change in temperature. Consequence of this assumption is that the as we know the mass of any matter doesn't change now as density also being constant the volume will also remain constant.

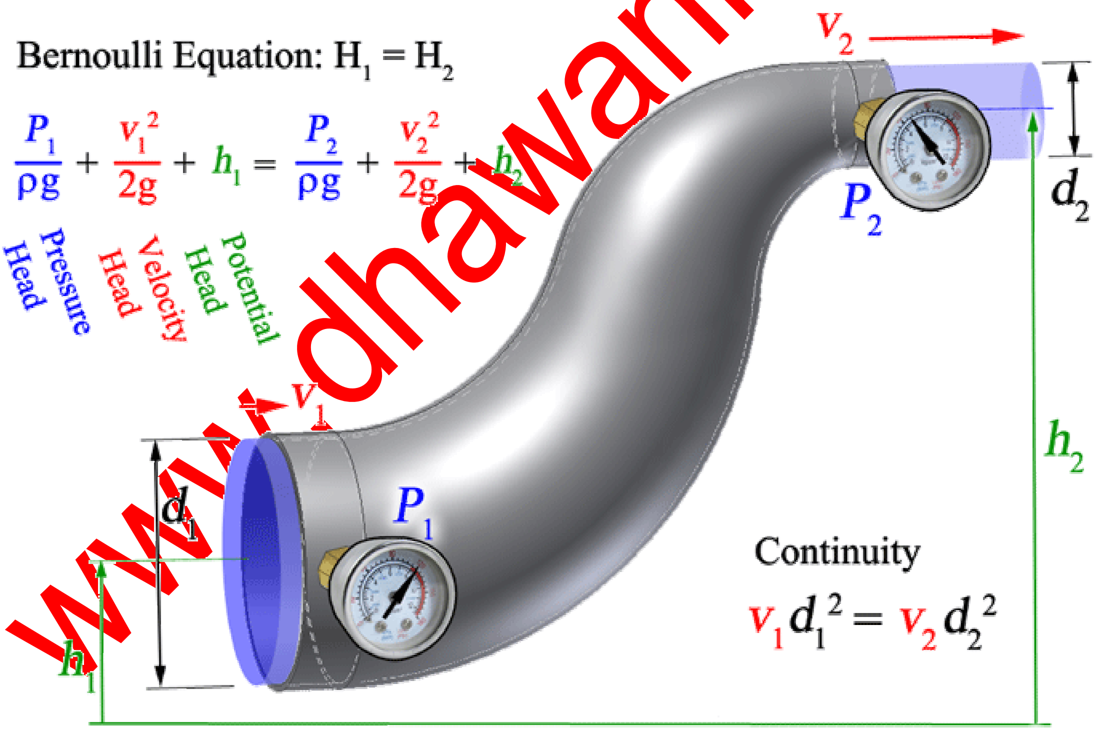
Second important aspect of the Ideal fluid, is that it is non viscous. In the third part of the chapter we will discuss viscosity, but for present you have to understand that it is liquid frictional force and hence is dissipative force.

In video we start with streamlines or velocity profile. It is that straight or curved path tangent to which gives the instantaneous direction of velocity of particle. Then important thing is about Laminar and Turbulent Flow. In fact the maximum velocity till which we can have laminar flow for a given set up is called critical velocity.

Next topic to understand, is concept of pressure energy. It is the third energy after kinetic energy, potential energy. The total pressure energy of volume V is PV. Where P is the pressure associated with volume V of liquid.

Based on concept of conservation of energy Bernoulli equation is used.

Mathematically $P + \frac{1}{2}\rho v^2 + \rho g h = \text{constant}$



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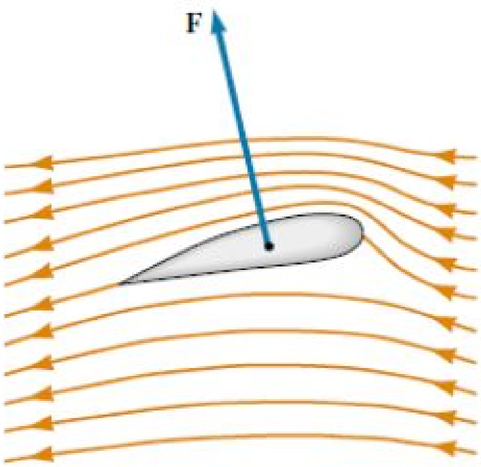
In consequence to this we have application of Bernoulli's

Air Lift : The force which helps to lift an air craft to the tune of 60%.

The wings are designed in such a shape that when air craft accelerated there exists a pressure difference. Upper portion has reduction in pressure due to increase in velocity head.

In almost all of the applications of Bernoulli the gravitational head does not play any role, so basically other two heads are only utilized.



Next is venturimeter, which is explained, It is an industrial product even.

It might look like an small unit, but in big industries we take too big of these as units

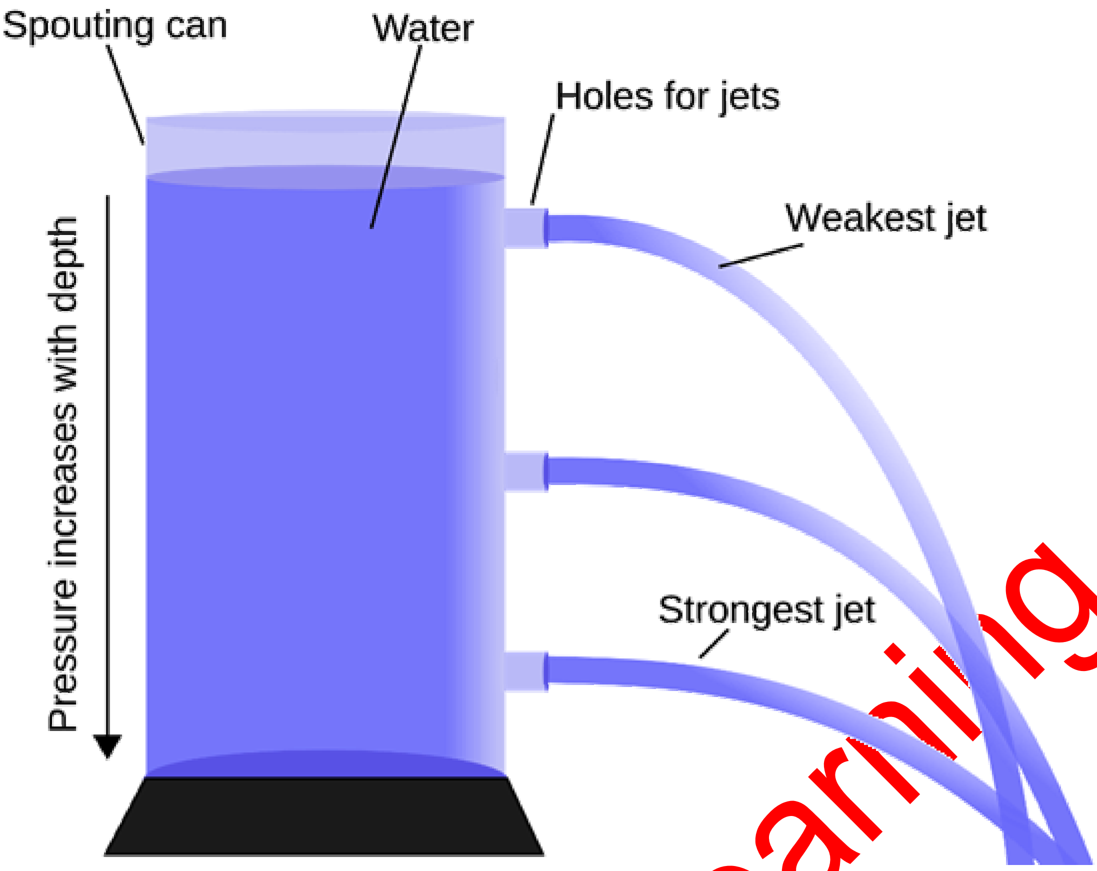
Also coming next is velocity of efflux.

This velocity depends on the height of liquid above the hole or jet. Bottom most will have high velocity but again it will remain for a short span in air (compare half projectile)

The top most has maximum time in air but agin its velocity is very less. So the range is less.

In fact for maximum range important is to keep it at half the height. We can even easily prove it.

You can see it as diagram also.



Magnus effect of spinning the ball in air is also case of Bernoulli equation only

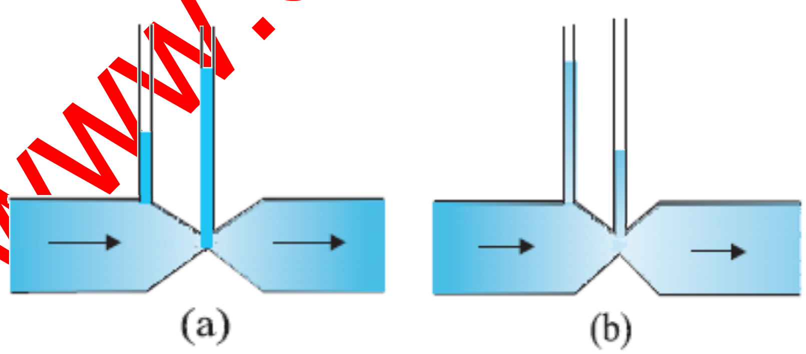
Atomizer is one more example

Now for questions from NCERT

10.13 Glycerine flows steadily through a horizontal tube of length 1.5 m and radius 1.0 cm. If the amount of glycerine collected per second at one end is 4.0×10^{-3} kg s^{-1}, what is the pressure difference between the two ends of the tube ? (Density of glycerine = 1.3×10^3 kg m^{-3} and viscosity of glycerine = 0.83 Pa s). [You may also like to check if the assumption of laminar flow in the tube is correct].

10.14 In a test experiment on a model aeroplane in a wind tunnel, the flow speeds on the upper and lower surfaces of the wing are 70 m/sand 63 m/s respectively. What is the lift on the wing if its area is 2.5 m^2 ? Take the density of air to be 1.3 kg/m3.

10.15 Figures 10.23(a) and (b) refer to the steady flow of a (non-viscous) liquid. Which of the two figures is incorrect ? Why ?



10.16 The cylindrical tube of a spray pump has a cross-section of 8.0 cm^2 one end of which has 40 fine holes each of diameter 1.0 mm. If the liquid flow inside the tube is 1.5 m/min, what is the speed of ejection of the liquid through the holes ?

10.27 A plane is in level flight at constant speed and each of its two wings has an area of 25 m^2. If the speed of the air is 180 km/h over the lower wing and 234 km/h over the upper wing surface, determine the plane's mass. (Take air density to be 1 kg/m^3).

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